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How to Select a Common-Mode Choke for Power Electronics

Zachariah Peterson

6-8 minutes



Those big coils in power supply units do more than just step up or down the voltage/current from the line values. The same can be said for power supply/management units that take power from batteries or other DC sources. EMI filtration is just one aspect of providing clean power to downstream components and preventing signal integrity problems due to strong conducted EMI.

When you need to place an EMI filter on the supply lines in your power system, you can use a common-mode choke to suppress common-mode conducted EMI into your system. Common-mode

chokes have other uses aside from power filtration as they can also filter any common-mode currents induced by radiated EMI. We'll present some guidelines for working with power systems, these guidelines can apply any time you need to select a common-mode choke for EMI filtration.

EMI Filtration with a Common-mode Choke

When connecting a power system to AC lines, noise can pass into the system as conducted EMI and interfere with proper functioning of power electronics and the components to which these systems deliver power. Common-mode chokes take advantage of magnetic induction to cancel out common-mode noise on input power lines in a power regulation, conditioning, or conversion system. There are some basic specifications that should be checked in datasheets when looking for a common-mode choke:

- **DC resistance.** The coils will have some DC resistance due to the thickness and length of the wire. For power electronics applications, this should be as low as possible to prevent power loss and excess heat from being dissipated in the coils.
- **Voltage and current ratings.** These electrical ratings should not be exceeded in your particular application. Note that the current rating tends to scale with DC resistance as thicker coils can handle greater current without getting too hot.
- **Common-mode attenuation.** This tells you how common-mode is attenuated at different frequencies. Note that an ideal common-mode choke will have a linear attenuation spectrum; this is not the case with real chokes. The choke's parasitic winding capacitance will create a resonance peak in the attenuation spectrum.

- **Winding capacitance.** Some common-mode chokes will specify this value, but you won't always find this in datasheets. A smaller winding capacitance is desirable for high-speed designs as you want to prevent nearby return currents noise from coupling common-mode onto the output of the choke.
- **ESD ratings.** When these chokes are used in high-voltage systems, then [ESD ratings](#) become important for safety. It also helps to check for standards compliance (UL and IEC standards are common for high voltage/telecom/industrial products).

Common-Mode Chokes for High Power Systems

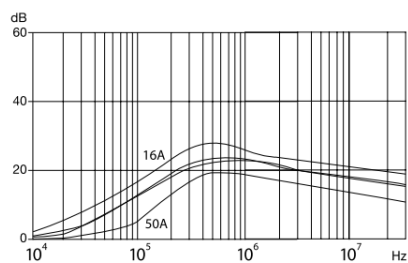
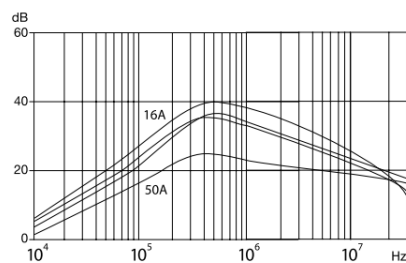
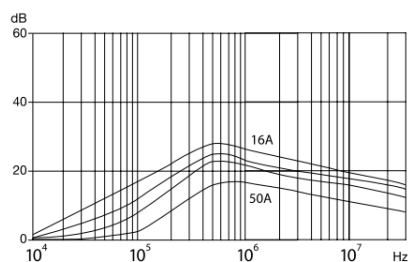
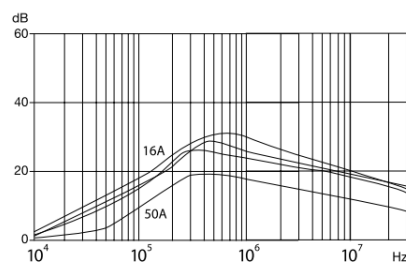
Chokes for high voltage/current systems are normally packaged in the same way as large inductors, and they function just like low-pass filters. The points mentioned above also apply to differential-mode chokes, and to chokes integrated into ICs. These chokes often come in arrays and are designed for high bandwidth applications like high-speed cameras (e.g., HDMI or MIPI), LVDS, or similar applications requiring filtration at the band edge.

For high power systems, you won't find these types of packages; common-mode chokes for high power applications are made from large ferrites or ferromagnetic materials with large copper coils. Here are some example common-mode choke options you'll find on the market:

Schaffner, RB6122-50-0M3

The [RB6122-50-0M3 common-mode choke from Schaffner](#) is ideal for high voltage AC power systems (rated up to 600 V AC) or high voltage DC systems (rated up to 1000 V DC), such as photovoltaic

installations or battery banks. The open coil design allows convection cooling along the coils and ensures relatively low winding capacitance. These coils are rated up to 50 A at 60 °C at up to 400 Hz operating frequency. The open design and low winding capacitance puts the attenuation resonance for these coils at ~500 kHz. Some typical resonance curves for RB6XXX and RB5XXX series components are shown below.

RB6122, RB6522**RB8522****RB6132, RB6532****RB8532**

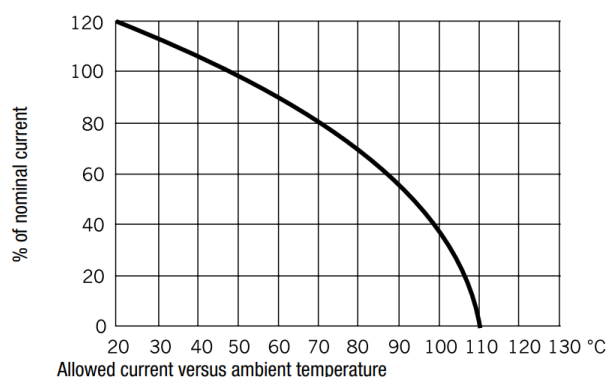
Attenuation resonance curves for other common-mode chokes from Schaffner. From the [RB6122-50-0M3 datasheet](#).

Bourns, 7105

This [4.25 mH common-mode choke coil from Bourns](#) is rated for up to 1 A DC current with 3750 RMS AC dielectric strength. This component is excellent for input filtration with high-voltage power converters. Other chokes in the 71XX series from Bourns provide up to 50 mH inductance (7121, 2 A max. current), or up to 10 A max. current (7124, 3 mH inductance). These through-hole common-mode chokes have a low profile with up to 1 in. by 1 in. cross-section when mounted on a PCB.

Schurter, DLFL-0147-25D2

The [DLFL-0147-25D2 common-mode choke from Schurter](#) is an iron-powdered toroidal common-mode choke with rated voltage up to 440 V AC @ 50 Hz. The maximum current rating (45 A at 25 °C) has sensitive derating as shown below and should not be used at excessively high temperatures. Despite the sensitive derating, it provides 2 kV effective isolation voltage and is compliant with the IEC 60068-1 Climatic Category 25/100/21. This component works best when mounted closest to the source of any conducted EMI into a circuit, although it can still be used for line filtration at moderate current.



Derating curve for the DLFL-0147-25D2 common-mode choke from Schurter. From the [DLFL-0147-25D2 datasheet](#).

Other Components for Power Management

Even after you select common-mode choke components and other filters for your system, you'll likely need a range of components for managing power distribution in your power supply. Here are some other common components needed for high voltage/current systems:

- [TVS diodes or other overvoltage protection components](#)

- [Inductors for use in PFC circuits and regulator stages](#)
- [Current-sense amplifiers and controllers](#)

There are plenty of components you can use to construct a low-pass filter for power supplies and power management systems, and common-mode choke coils are one option for EMI filtration. When you need these or other components for your next system, use the [advanced search and filtration features](#) in Octopart when you need a complete solution for electronics sourcing. [Take a look at our power management integrated circuits page](#) to find some other components you'll need for power electronics.

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